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14. ABSTRACT Coordinated, multi-institutional research (University of Wisconsin, Stanford University, the University of Kansas, the University of California-Davis, and Florida State University) is addressing key underlying scientific and engineering issues of Generation II Coated Conductors is fabricating and acquiring through collaborations forefront CC samples, developing new tools for their understanding and characterizing them so as to resolve key performance issues. Areas of concentration include substrates, buffer layers, the superconducting overlayer, their complex interactions, and the underlying physical mechanisms that determine conductor performance. Our thrusts have covered study of grain boundaries, electromagnetic characterization, fabrication of model samples relevant to coated conductors, nanoscale characterization by scanning probe and scanning transmission electron microscopies, and the formulation of detailed models of how and why low angle grain boundaries and other macroscopic obstacles become barriers to current flow. We consider the way in which epitaxy develops through from an IBAD or deformation-textured substrate, the choice of oxide buffer layer and the influence of the buffer layer formation method. Strong interactions with leading companies, the DOE laboratories and AFRL and other universities are in place.				
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Report on the Wisconsin-Stanford-Kansas-Davis-Florida State MURI on Scientific Challenges of Coated Conductors

July 1, 2005 – June 30, 2006

I. Summary

Strong progress in Coated Conductor (CC) development occurred in the past year and the MURI remained at the forefront of integrating an understanding of several key aspects of the science with the technology. Major advances have been made in understanding and bettering flux pinning, understanding and mitigating grain boundary effects in CC and in beginning to understand protection and stability issues for CC. The MURI will end on December 31, 2006 after a 6 month close out. Several of the principals from the University of Wisconsin are relocating to the National High Magnetic Field Laboratory at Florida State University, who have made a major offer to move the Applied Superconductivity Center to a new facility at the Shaw Building just across the street from the main building of the National High Magnetic Field Laboratory. The Applied Superconductivity Center will become a division of the National High Magnetic Field Laboratory with David Larbalestier as Director of ASC. Alex Gurevich and Eric Hellstrom will join ASC in late 2006 and summer 2007, respectively. Essentially all of the equipment belonging to Applied Superconductivity Center will move to the NHMFL and a considerable enhancement of our capability will be made with the FSU start-up package. Prominent in this package is 25,000 square feet of purpose remodeled space, a dual-beam FIB/HRSEM with full analytical capability and a 16T Quantum Design PPMS system.

This report will be very brief, confining itself to a list of topics and papers published in the year since a final cumulative report of the MURI is now in preparation.

II UW work (Principals - Eom, Feldmann, Gurevich, Hellstrom, Larbalestier, Polyanskii and Song)

Work at UW falls under the general thrusts of:

- a. The thickness dependence of the critical current density
- b. Grain growth and grain boundary effects
- c. TEM studies of grain boundaries and pinning effects in CC
- d. Construction and operation of a Low Temperature Scanning Laser Microscope (LTLSM) and use of Magneto Optical Imaging for identification of local current flow obstructions
- e. Growth of YBCO or other RE-123 films using F-free solution methods
- f. Growth studies of YBCO films using PLD

III Stanford University - PIs Malcolm Beasley and Katherine Moler

The Stanford subprogram of the larger MURI program is focused on the development and the application of scanning Hall probe microscopy and scanning tunneling potentiometry for use in coated conductor physical characterization.

IV. Kansas (PI Judy Wu)

In this 12-months period of the MURI project, the University of Kansas group has worked on several issues related to the coated conductor development. We continued our effort in engineering microstructures of thick YBCO films and coated conductors with the goal to improve the current carrying capability and magnetic flux pinning. This includes insertion of nanoparticles, nanopores, nano-tubes, and nano-planes into the YBCO films. To fully assess the correlation between the microstructure and superconducting properties, normal state resistivity and J_c values have been measured as functions of temperature and magnetic field. We have studied the defect morphology through the film thickness using SEM and ion milling and observed nanotube-like pore growth in micron thick YBCO films. In addition, the J_c -thickness behavior at different temperatures and fields has been studied YBCO films of variable thickness and YBCO/insulator/YBCO trilayered samples. We have continued developing our near-field microwave microscope/near-field optical microscope (NSMM/NSOM) dual probe, together with I-V measurement, for electrical current mapping in coated conductors.

V Florida State University (PI Justin Schwartz)

The work covers the quench behavior of commercially produced coated conductors subjected to a localized transient heat disturbance.

UW Papers

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University of Kansas Papers

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